CLAIMS

1. A fuel cell system (20) comprising a fuel cell stack (1) effecting power generation upon supply of a reactive gas, the fuel cell stack (1) comprising a reactive gas passage (115, 1c, 116, 1a) and a water passage (117, 1b) substantially parallel to the reactive gas passage (115, 1c, 116, 1a), the reactive gas passage (115, 1c, 116, 1a) and the water passage (117, 1b) being separated by a porous member (112c, 112a), the reactive gas being humidified by water permeating through the porous member (112a, 112c), the fuel cell system (20) comprising:

a reactive gas pressure control valve (5, 6) which controls a reactive gas pressure supplied to the reactive gas passage (115, 1c, 116, 1a);

a water pressure sensor (3a, 3b) which detects a water pressure in the water passage (117, 1b); and

a programmable controller (13) programmed to:

calculate a pressure reduction amount in the reactive gas passage (115, 1c, 116, 1a) based on a power generation load of the fuel cell stack (1) (S120, S140);

calculate a pressure reduction amount in the water passage based on the power generation load of the fuel cell stack (1) (S130);

calculate, from the pressure reduction amount in the water passage (117, 1b) and the pressure reduction amount in the reactive gas passage (115, 1c, 116, 1a), a target pressure of the reactive gas supplied to the

reactive gas passage (115, 1c, 116; 1a) such that a pressure difference between the reactive gas passage (115, 1c, 116, 1a) and the water passage (117, 1b) is within a predetermined range (S160, S170); and

control the reactive gas pressure control valve (5, 6) based on the target pressure (S180, S190).

2. The fuel cell system (20) as defined in Claim 1, wherein the predetermined range is set to a pressure difference range which allows the water in the water passage (117, 1b) to permeate through the porous member (112a, 112c) to the reactive gas passage (115, 1c, 116, 1a) while preventing condensation of water in the reactive gas passage (115, 1c, 116, 1a).

3. The fuel cell system (20) as defined in Claim 1 or Claim 2, wherein the fuel cell system (20) further comprises a pump (7) which supplies water to the water passage (117, 1b), and the controller (13) is further programmed to control a rotating speed of the pump (7) according to the power generation load of the fuel cell stack (1) (139).

4. The fuel cell system (20) as defined in Claim 3, wherein the controller (13) is further programmed to prevent the rotating speed of the pump (7) from decreasing at a rate larger than a predetermined rate when the power generation load of the fuel cell stack (1) decreases (S240, S250, S260).

5. The fuel cell system (20) as defined in any one of Claim 1 through Claim 4, wherein the fuel cell system (20) further comprises a gas pressure sensor (2a, 4a) which detects a pressure of the reactive gas supplied from the reactive gas pressure control valve (5, 6) to the reactive gas passage (115, 1c, 116, 1a), and the controller (13) is further programmed to control the reactive gas pressure control valve (5, 6) to cause the pressure detected by the gas pressure sensor (2a, 4a) to coincide with the target pressure of the reactive gas.

6. The fuel cell system (20) as defined in any one of Claim 1 through Claim 4, wherein the reactive gas passage (115, 1c, 116, 1a) comprises a first gas passage end(1aA, 1cA) and a second gas passage end (1aB, 1cB), the water passage (117, 1b) comprises a first water passage end(1bA) in the vicinity of the first gas passage end (1aA, 1cA) and a second water passage end (1bB) in the vicinity of the second gas passage end (1aB, 1cB), and the controller (13) is further programmed to determine a target pressure of the reactive gas supplied to the reactive gas passage (115, 1c, 116, 1a) to cause a pressure difference between a pressure at the first gas passage end(1aA, 1cA) and a pressure at the first water passage end (1bA) and a pressure difference between a pressure at the second gas passage end (1bB) to be both within a predetermined range (S180, S190).

7. The fuel cell system (20) as defined in Claim 6, wherein the reactive gas is

supplied from the first gas passage end (1aA, 1cA) to the reactive gas passage (115, 1c, 116, 1a), and the water is supplied from the second water passage end (1bB) to the water passage (117, 1b).

8. The fuel cell system (20) as defined in Claim 7, wherein the water pressure sensor (3a, 3b) is a sensor (3a) which detects a pressure at the first water passage end (1bA).

9. The fuel cell system (20) as defined in Claim 8, wherein the controller (13) is further programmed to calculate a required pressure of the reactive gas based on the power generation load of the fuel cell stack (1) (S110), calculate, from the pressure reduction amount in the water passage (117, 1b), and the pressure reduction amount in the reactive gas passage (115, 1c, 116, 1a), a target pressure range of the reactive gas supplied to the reactive gas passage (115, 1c, 116, 1a) such that the difference in pressure between the reactive gas passage (115, 1c, 116, 1a) and the water passage (117, 1b) is within a predetermine range (S160, S170), and calculate the target pressure by limiting the required pressure within the target pressure range (S184 through S187, S194 through S197).

10. The fuel cell system (20) as defined in Claim 9, wherein the controller (13) is further programmed to determine the target pressure range by an upper limit value P_{Gu} and a lower limit value P_{Gl} determined by the following

equations:

$P_{Gu} = P_{Wo} + \Delta P_{max}$

$P_{Gl} = P_{Wi} + \Delta P_{min} + \Delta P_G$

where, P_{Wo} = the pressure at the first water passage end (1bA);

ΔP_{max} = a maximum pressure difference with which the water in the water passage (117, 1b) can permeate through the porous member (112a, 112c) to reach the reactive gas passage (115, 1c, 116, 1a);

P_{Wi} = the pressure at the second water passage end (1bB) = $P_{Wo} + \Delta P_W$;

ΔP_W = the pressure reduction amount in the water passage (117, 1b);

ΔP_{min} = a minimum pressure difference which causes no water condensation in the reactive gas passage (115, 1c, 116, 1a); and

ΔP_G = the pressure reduction amount in the reactive gas passage (115, 1c, 116, 1a).

11. The fuel cell system (20) as defined in any one of Claim 1 through Claim 4, wherein the reactive gas comprises hydrogen.

12. The fuel cell system (20) as defined in Claim 1, wherein the reactive gas passage (115, 1c, 116, 1a) comprises an air passage (115, 1c), the reactive gas pressure control valve (5, 6) comprises an air pressure control valve (5) which controls an air pressure supplied to the air passage (115, 1c), and the controller (13) is further programmed to calculate a pressure reduction

amount in the air passage (115, 1c) based on the power generation load of the fuel cell stack (1) (S120, S140), calculate, from the pressure reduction amount in the water passage (117, 1b) and the pressure reduction amount in the air passage (115, 1c), a target pressure of air supplied to the air passage (115, 1c) such that a pressure difference between the air passage (115, 1c) and the water passage (117, 1b) is within a predetermined range (S160, S170), and control the air pressure control valve (5) based on the target pressure of air supplied to the air passage (115, 1c).

13. The fuel cell system (20) as defined in Claim 7, wherein the water pressure sensor (3a, 3b) comprises a sensor (3a) which detects a pressure at the first water passage end (1bA) and a sensor (3b) which detects a pressure at the second water passage end (1bB), the fuel cell system (20) further comprises a recirculation passage (14) which recirculates reactive gas discharged from the second gas passage end (1aB) to the first gas passage end (1aA), the fuel cell system (20) further comprises a sensor (2a, 4a) which detects a gas pressure at the first gas passage end (1aA, 1cA), a sensor (2b, 4b) which detects a gas pressure at the second gas passage end (1aB, 1cB), and the controller (13) is further programmed to calculate the pressure reduction amount in the water passage (117, 1b) from the difference between the pressure at the second water passage end (1bB) and the pressure at the first water passage end (1bA) (S130, 133), and calculate the pressure reduction amount in the reactive gas passage (115, 1c, 116, 1a) from the

difference between the gas pressure at the first gas passage end (1aA, 1cA) and the gas pressure at the second gas passage end (1aB, 1cB) (S120, 133, S140, 134).